TOP SECRET

Joint Photographic Intelligence Report

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URANIUM MINING AND MILLING COMPLEX

PYATIGORSK, USSR

PIC/JR-6/59
MAY 1959

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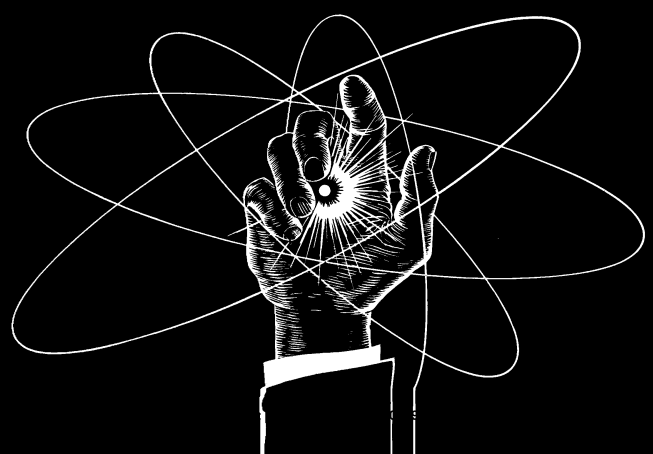

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PREFACE

This Joint Photographic Intelligence Report has been prepared by the Army, Navy, and Central Intelligence Agency, under CIA chairmanship. Its scope is intended to meet the combined requirements of the intelligence community as specified in the following requirements: JAEIC Requirement HTA/SI/R-79/57, Army Requirement SRI-250-1-57 and Navy Requirement OP922Y3 Project 23-58.

Geological data was supplied by the Geographic Division, Office of Research and Reports, CIA, and the U. S. Geological Survey.

This report is based on all intelligence information available as of 1 September 1958 derived from a large number of refugee sources, clandestine reports, open literature and aerial and ground photography.

For further clarification of several references cited in this report it should be noted that a conference on uranium mining and milling met during the period 9 - 13 June 1958 for the members of Joint Project 19-57/D; the Nuclear Energy Division, OSI, CIA; and the Joint Atomic Energy Intelligence Committee (JAEIC). Consultants to the conference 25X1 were [redacted] photogeologist with the U. S. Geological Survey; [redacted] 25X1 25X1 [redacted] uranium mining engineer for the [redacted] 25X1 independent uranium mill designer.

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FIG. 1 GENERAL LOCATION MAP The Pyatigorsk uranium mining and milling complex is located in the Northern Caucasus foothills, about midway between the Black Sea and the Caspian Sea. Pyatigorsk is on the same parallel as Bangor, Maine, and Alma Ata, USSR.

INTRODUCTION

The Pyatigorsk uranium mining and milling complex is located northwest of the city of Pyatigorsk at 44°06'N/42°57'E, in the northern foothills of the Caucasus Mountains. The complex is about 296 nautical miles (nm) ESE of Kerch, 286 nm south of Stalingrad, and 378 nm northwest of Baku.

Little was known about the mining activity at Pyatigorsk until the aerial photography of [redacted] was examined. Then it became apparent that a major new industrial complex had been established. 25X1

According to prisoner of war (PW) interrogation reports, drilling began on the east slope of Gora Beshtau in 1946. During the next two years the area underwent rapid development. Workers' homes were built and power lines were extended to the mine. It was rumored in Pyatigorsk that uranium had been discovered. 1/ Products from the mine were carried either to the Pyatigorsk railroad station or in the direction of the city of Mineral'nyye Vody by truck. German prefabricated barracks were shipped into the area during the fall of 1947. About a year later they were taken to the mine and erected. 2/

It was also reported that a power plant was under construction six to seven nm west of Pyatigorsk in 1947, and that the plant would use water power from the Podkumok River. 3/

In 1956 military attaches were able to take photographs of the uranium plant from a distance on two separate occasions. One cooling tower was noted, and the tops of a number of buildings were visible. The only conclusion at that time was that it was an unidentified industry. The waste pond and pipeline also appear in the photos. The ponds in the area had a yellow hue. The area was surrounded by a barbed-wire fence and appeared to be well-secured. 4/

• • •

SUMMARY AND CONCLUSIONS

The Pyatigorsk uranium plant is one of the largest producers of uranium oxide in the USSR. It is a well-organized plant capable of producing an estimated 4000 pounds of uranium oxide a day, or about 700 metric tons a year. Both the plant and the supporting facilities appeared to be in full-scale operation at the time of photography.

The plant consists of a concentration facility that probably uses the ion exchange method of ore refining. Within the overall complex there are several support facilities, including a power plant that serves both the mines and the mill. Ore reserves in the area appear to be extensive, and the quality of the ore appears to be better than previously estimated by a factor of two or three.

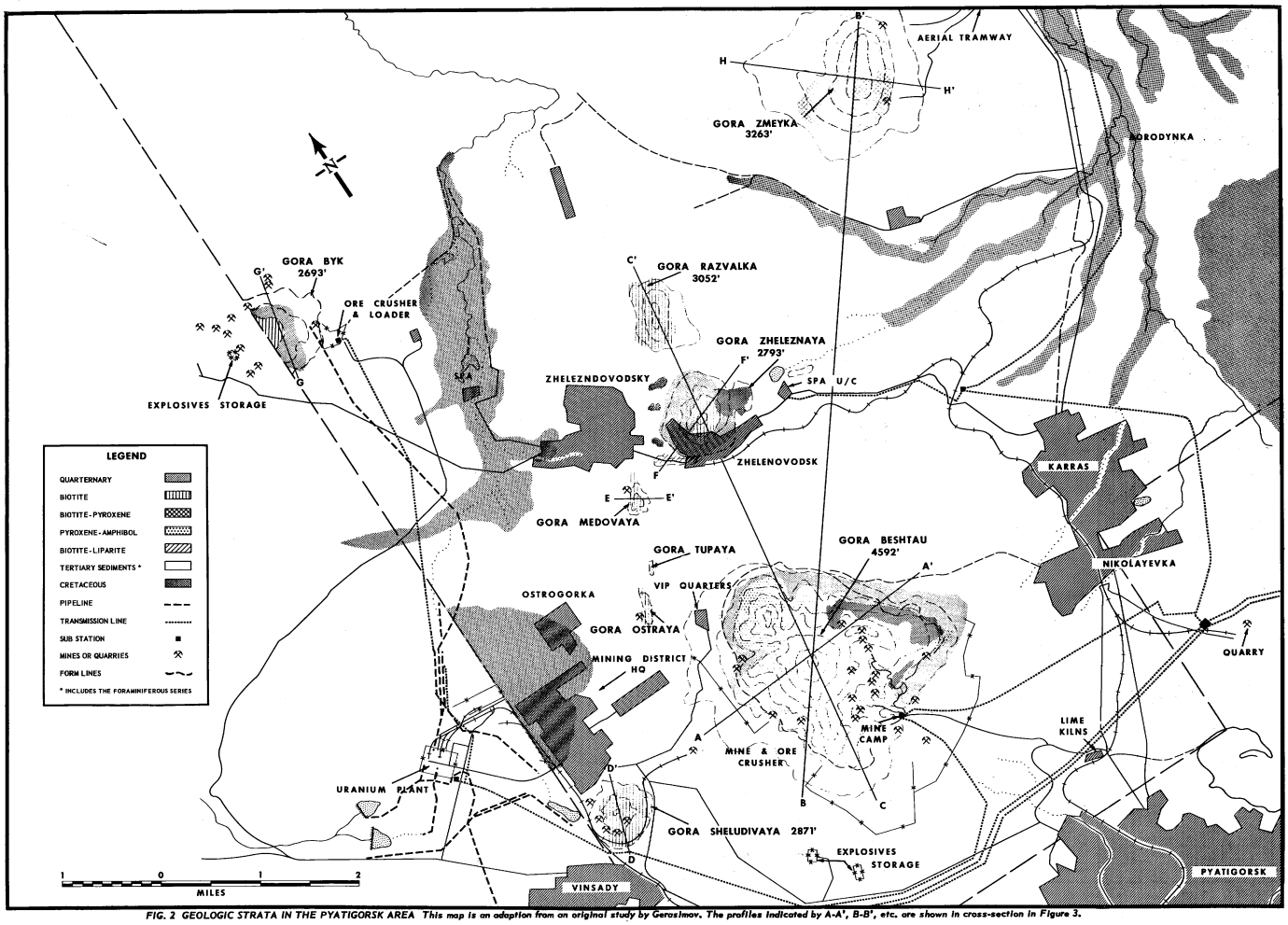

FIG. 2 GEOLOGIC STRATA IN THE PYATIGORSK AREA This map is an adaption from an original study by Gerasimov. The profiles indicated by A-A', B-B', etc. are shown in cross-section in Figure 3.

GEOLOGY

Exploitation of the mineral wealth of the Pyatigorsk region began with the creation of spas in the mineral spring area as early as 1717. The basic interest in the region remained the mineral springs until the early 1900's. 5/

Russian geologists of the mid-1920's considered the Caucasus to be an area of little mineral wealth, but opinion has since changed. It is now known to be an area of considerable mineral wealth including a few areas containing uranium. 6/

Volcanic activity in the Pyatigorsk area of the Northern Caucasus foothills is expressed in the form of igneous masses or laccoliths forming isolated peaks, the highest of which is Gora Beshtau (Beshtau Mountain) at an elevation of 4592 feet. Other significant peaks include Gora Byk, Gora Verblud, Gora Razvalka, Gora Dzhuga and Gora Zolotoy Kurgan. 7/

The area from Pyatigorsk to Essentuki to the west, and south and west of Gora Beshtau, forms a small plateau which is the core of the uranium complex. The terrain slopes northward from the plateau into the valley in which Mineral'nyye Vody is located. This otherwise gradual slope is interrupted by four main laccoliths, Gora Zheleznaya, Gora Razvalka, Gora Zmeyka and Gora Byk. The terrain to the northwest is similar, broken only by Gora Verblyud. South of this small plateau the terrain rises rapidly, is broken with numerous drainage channels, and forms the threshold of the Caucasus.

Since radium and uranium exploration began seriously in the 1920's, prospecting has uncovered many deposits and the region is now believed to have significant amounts of radioactive ore. Uranium is reported to occur in a few small polymetallic deposits, in placers, in limestone, in igneous rocks, and in deposits of an unspecified type in the Beshtau hot springs area. 8/

The Russian geologist Pavlinov has apparently done the most significant work in recent years. He analyzed the structures and made a detailed survey of the major intrusions of the Pyatigorsk region. 9/ (See Figures 2 and 3.)

Gerasimov, another Soviet geologist, stated his belief in 1937 that all of the intrusives came from a common magma. 10/ Also, it is reported that all of the intrusives are abnormally radioactive.

The area included in the uranium field is approximately 13 nm in diameter and contains about 11 small plutonic bodies expressed as peaks throughout the area. These plutonic bodies are variously reported to be trachyte, latite or dacite, but all of them apparently contain quartz as well as some minerals of the pyroxene-amphibole series.

The locations of laccoliths are easily recognized on the photography by their prominent out-crops, which are the only interruptions to otherwise undulating terrain. Structures of interest consist of about sixteen laccoliths intruding the Cretaceous, Tertiary, and Quaternary layers. The chief peak is Gora Beshtau. The laccoliths are atypical, pear-like, assymmetrical massifs, which are complicated by repeated intrusions of magma under bysmalithic conditions. All the igneous rocks are partly crystalline in texture.

There are two primary areas of mining, Beshtau and Byk. Limestone is reported to be in contact with the igneous rock at Byk, but at Beshtau the igneous rock is believed to be in contact with sandstones and shales of Tertiary and Cretaceous age. Some of the sediments are reported to be relatively carbonaceous, with the carbonaceous material concentrated near the contact and in the fissures. The literature also states that black veinlets occur on the slope of Gora Tupaya. This would be in the igneous body, and the veinlets were said to contain about twenty percent manganese oxide with some limonite. 11/

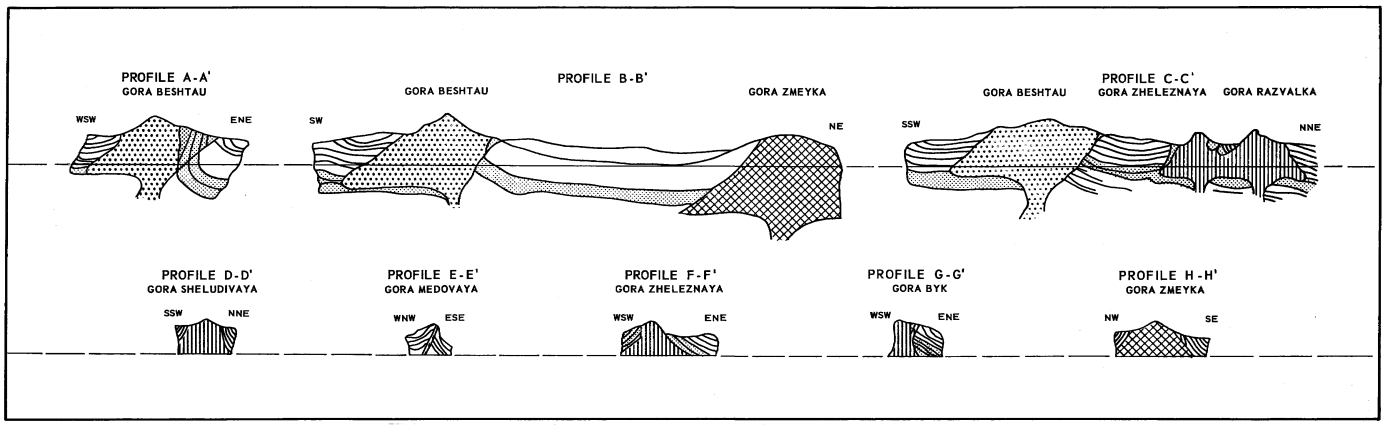

FIG. 3 PROFILES OF LACCOLITHS IN THE PYATIGORSK AREA See Fig. 2 for location and legend for the above profiles

FIG. 4 MOSAIC OF THE PYATIGORSK AREA Showing the principal features of the uranium mining and milling complex

25X1

MINING ACTIVITIES

There are several intelligence reports on uranium ore mining in the Pyatigorsk district. The ore, said to be dark-gray to brown rock resembling coal, has been estimated by one source to be low grade, perhaps averaging less than 0.1 percent uranium oxide. The same source stated that there was a reserve of only a few hundred tons. 12/

The size and scope of the operation, as evidenced on the photography, indicate a reserve much greater than several hundred tons, and ore of a quality nearer 0.2 percent uranium oxide. The ore shoots are probably small, and could run to pitchblende, which would assay much higher than 0.2 percent.

PROSPECTING

Scars from test borings are visible at scattered points on Gora Beshtau; on all slopes of Gora Sheludivaya; on Gora Byk; particularly on the east slope; on Gora Verblyud; on Gora Medovaya; on Gora Ostraya; on Gora Razvalka; on Gora Kinzhal; on Gora Lysaya; on Gora Zolotoy Kurgan; and on Gora Dzhuga.* These scars appear primarily in the form of trenching.

It is quite evident that prospecting in the area has been very extensive. There are probably many drill holes which are not visible, and certainly there is an unusual amount of trenching. It seems that, unless the Soviets had found significant amounts of good quality ore, an expensive modern installation such as this would not have been programmed. 13/

* The latter four mountains are not shown on the mosaic (Fig. 4). Gora Kinzhal is located 11 nm north of Gora Beshtau; Gora Lysaya 8 nm to the east; Gora Zolotoy Kurgan 10 nm SSE; and Gora Dzhuga 11 nm south.

MINING

An analysis of the photography indicates that there are two general types of mining in the Pyatigorsk area. One type exploits fissures in the igneous rock* and the other exploits the surrounding sediments. It is quite evident that cracks and fissures are being exploited, because of the linear arrangement of the mines. Another indication that something narrow is being mined is the fact that there are large waste dumps outside of the adits of most of the mines. 14/ (A large quantity of waste is an indication of the mining of small veins.)

* The fissures occur mostly in the igneous areas, but occasionally extend into the sediments.

It has been reported that the waste material is chalk-like, which might mean that there had been some hydrothermal alteration of the fissures. It is possible that both uranium and manganese have been concentrated in the cracks and fissures of the Pyatigorsk region. If so, the U.S. Geological Survey (USGS) speculation that there are both vein-like deposits of carbonaceous material and vein-like deposits of manganese may be correct. 15/

The mineral deposits apparently have been discovered rather readily by following the various breaks across the country. The mines are apparently near the surface, probably not reaching below a thousand feet in depth. Their lateral extent may be great, however, because they follow out the veins. 16/

Uranium mining is primarily an underground operation. In the Pyatigorsk complex there appear to be horizontal adits sunk into the mountainside. Several of the adits are served by narrow-gauge railways. Surface activities on some of the exposed laccoliths are possibly rock quarries, but they could also be open-pit mines.

Predominant among the latter type are the six open-pit mines on the slopes of Gora Sheludivaya. Other probable rock quarries are in evidence on Gora Razvalka, Gora Dzhuga and Gora Zolotoy Kurgan. It is quite possible, of course, that prospecting activity is associated with all of the quarrying activity, and that in the future ore mines will be located on all of the mountains.

In addition to the supporting facilities at Gora Beshtau and Gora Byk, there are a number of minor facilities associated with the other mining activities.

There are explosives storage areas adjacent to many of the mining activities. On the south slope of Beshtau there are two double-fenced explosives storage areas. A third is situated on the east slope of Sheludivaya, a fourth on the west slope of Byk, a fifth on the north slope of Zmeyka, and a sixth just northeast of Gora Dzhuga.

An ore loader and a storage and supply area on a rail siding on the northwest side of Sheludivaya may be associated with road materials rather than uranium ore processing. A mining camp situated on the northeast side of Gora Beshtau contains 25-30 buildings of various sizes.

There are storage and supply facilities about 1000 feet south of the Gora Kinzhal open-pit mine operations, with an associated probable truck park.

PHOTOGEOLOGICAL ANALYSIS

According to an analysis [ ] during the mining and milling consultants' conference, there appear to be two general types of mineral exploitation in the Pyatigorsk area:

1. Exploitation of deposits of uranium and manganese present along fissures or veins. Most of the deposits of this type are in igneous rock, and most of the mines in the Pyatigorsk region are exploiting deposits of this type.
2. Exploitation of deposits within the sedimentary rock surrounding the igneous areas. These mines are large and, although few in number, they may be the major source of supply of ore for the concentrating plant.

The Pyatigorsk deposits are rather unusual in that the uranium may be chemically associated with manganese in the vein-type deposits. **

[ ] is a photogeologist with the USGS. He prepared the above photogeological analysis on 4 May 1959 during a brief review of the text of this report.

** Elsewhere in the world there is no known large or high-grade uraniferous manganese deposit, though small and relatively low-grade concentrations of uranium occur with manganese carbonate in veins in the Black Hills of South Dakota. It seems probable that the Beshtau deposits are more important than any other known deposits of this type.

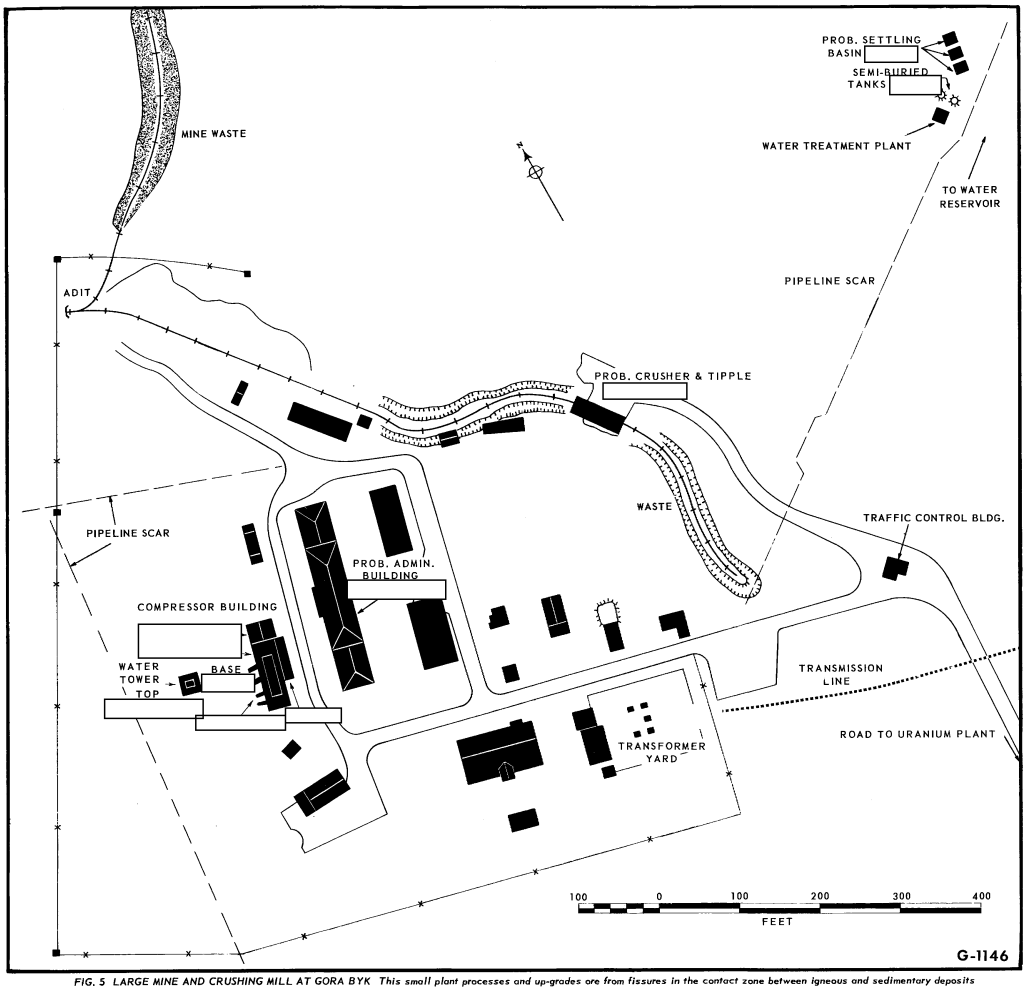

FIG. 5 LARGE MINE AND CRUSHING MILL AT GORA BYK This small plant processes and up-grades ore from fissures in the contact zone between igneous and sedimentary deposits

All mining activity in the Pyatigorsk complex lies within 13 nm of Gora Beshtau, the most important mining location. The four sites that do not appear on the mosaic (Figure 4), including Gora Kinzhal, Gora Lysaya, Gora Dzhuga and Gora Zolotoy Kurgan, were probably not producing any ore at the time of photography.

Gora Byk: The most important mining activity at Gora Byk is on the east slope about five nm north of the main processing plant. (See Figure 5.) The largest mine is in the sediment area, located along an alignment of features that can be seen clearly on the photography. Associated with this large mine there is what appears to be a crushing mill.

Ore is removed from the mine by ore cars and taken directly to the crusher. It appears that the ore is classified after crushing, because there is a pile of dark-toned waste beside the crusher building.

The up-graded ore is loaded on trucks which back under the crushing plant from the loading apron. There is a good road from the crushing plant to the processing plant nine nm by road to the south.

The installation probably serves as a general service and administration center for all of the mines in the Gora Byk area. A small complex of buildings near the mine adit includes a probable administration building, a compressor building, and a transformer yard. The complex is served by a transmission line leading from the power plant in the main milling area to the transformer yard. Water is apparently supplied to the area by pipeline, as evidenced by earth scars that enter the area from the south and northeast.

Gora Beshtau: The largest mine in the Pyatigorsk area is located on the southwest slope of Gora Beshtau, about three nm east of the uranium plant. Ore from

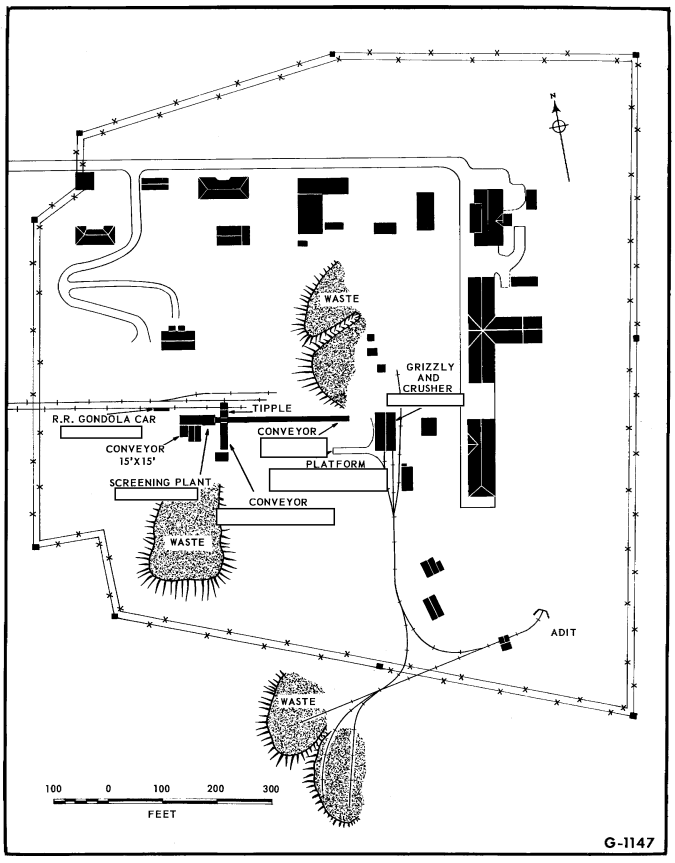

FIG. 6 LARGE MINE AND PRIMARY PROCESSING PLANT AT GORA BESHTAU This plant up-grades ore probably mined from sedimentary deposits on the west side of Gora Beshtau

this mine is probably the major source of supply for the plant.

The photographs show that the mine at Gora Beshtau is located in the sediments near the margin of the igneous intrusion. The sediments exposed at the surface are of two types, 1) a bedded sequence reported to be part of the Foraminiferal Series of Tertiary age, and 2) an overlying series, probably continental and probably composed of poorly-cemented, permeable material. These latter deposits are approximately 100 feet thick and may be locally derived. 17/

Primary Processing at Mines: The large mine on the west slope of Gora Beshtau is situated within a double-fenced complex that includes a grizzly in the crusher building, and a modern screening plant, including a tipple. The complex is rail-served by a spur line from the main processing plant three nm to the west.

Ore cars deliver the ore from the mine to the grizzly in the southwest corner of the crusher building. After crushing, the ore is given a coarse screening and then transported by conveyor to a multi-decked screening plant.

The screening plant appears to be new, and from the size of the waste dump it can be estimated that the plant had not been in operation more than a year at the time of photography.

At the screening plant, the fine material drops directly into rail cars through a hopper, and the sand is dumped to the side. The ore is then transported by rail to the processing plant.

It appears from the size of this primary processing plant that the input could be as high as 1000-1500 tons a day, yielding perhaps 100 tons of up-graded ore. 18/*

Other Mining Activity: All of the other mines in the area are apparently located along the alignment of features mentioned above, or along steep-sided valleys that may represent fissures or dikes. It appears probable that the mines at Gora Beshtau and Gora Byk were the only ones producing ore for the plant at the time of photography, and that the other mines are being held in reserve or are used for quarrying rock for road surfacing.

Mine Power Supply: A well-developed power grid radiates from the power plant at the main processing mill and serves most of the major mining operations of the Pyatigorsk complex. The facility on the west slope of Gora Beshtau appears to have its own boilerhouse, but may also be served by a line from the main plant.

The mine on the east slope of Gora Beshtau is connected with the regional power grid in addition to its local supply from the processing plant. Other transmission lines from the central power plant serve the Gora Byk installation and the mine operations at Gora Sheludivaya, Gora Zmeyka and Gora Verblyud.

It is probable that Gora Razvalka, Gora Dzhuga, and Gora Zolotoy Kurgan also are tied into the grid for their power supply, but transmission lines cannot be identified. Gora Ostraya, Gora Medovaya, and Gora Kinzhal do not appear to have a power supply.

* Based on the type of ore and the type of primary processing plant, it is estimated that the ore could be up-graded to .15 or .2 percent uranium oxide.

PROCESSING

The most significant installation of the Pyatigorsk mining and milling complex is the processing plant, which is estimated to be capable of producing 4000 pounds of uranium a day or about 700 metric tons a year. 19/*

PROCESSING PLANT

The processing plant is located on a narrow plateau about three nm WNW of Gora Beshtau, seven nm northwest of Pyatigorsk.

Plant Layout: The processing plant is contained within a fenced area enclosing about 50 acres. The processing buildings occupy about half of the complex, a large thermal power plant with its associated cooling towers and coal supplies occupies another third, and a small administrative unit arranged along the eastern fence line takes up the remaining space. The entire area is surrounded by both a wall and a fence, and there is a guard post at the main gate.

The four principal buildings of the processing plant are Building 6, * where ore is received and bedded; Building 5, where it is crushed and screened; Building 3, where it is pulverized and leached with acid; and Building 7, where the uranium oxide is separated from the slurry, probably by the ion exchange process.

Ore Receiving: The main ore receiving and bedding building, Building 6, is a large [redacted] gable-roofed structure served by a rail spur. It appears probable that all coarse ore arriving directly from the mines is received at Building 6, while finer ore from the primary processing plant associated with the large mine at Gora Beshtau is probably received at Building 1.

Crushing and Grinding: Ore is carried by conveyor from Building 6 to Building 5, where it is crushed, screened, and conveyed on to Building 3. Ore received at Building 1 is processed through Building 2 on its way to Building 3. Building 2 is probably a sorting and sampling facility.

Acid Leaching: After grinding, the ore is moved into the main section of Building 3 for acid leaching. Heat is probably used to aid the agitation of the slurry. Small flues on top of Building 3 could be used to dissipate heat as well as acid fumes. 25X1

The discharge from the leach tanks is probably fed directly to washing filters, from which a solution would be recovered. There would probably be two or three filtration stages, with repulpers between each stage.

The solutions and tailings would then be pumped to Building 7. The pachuca tanks

* The analysis in this section is based on the referenced transcript of the consultants' conference.

* Building numbers refer to annotations on Fig. 8.

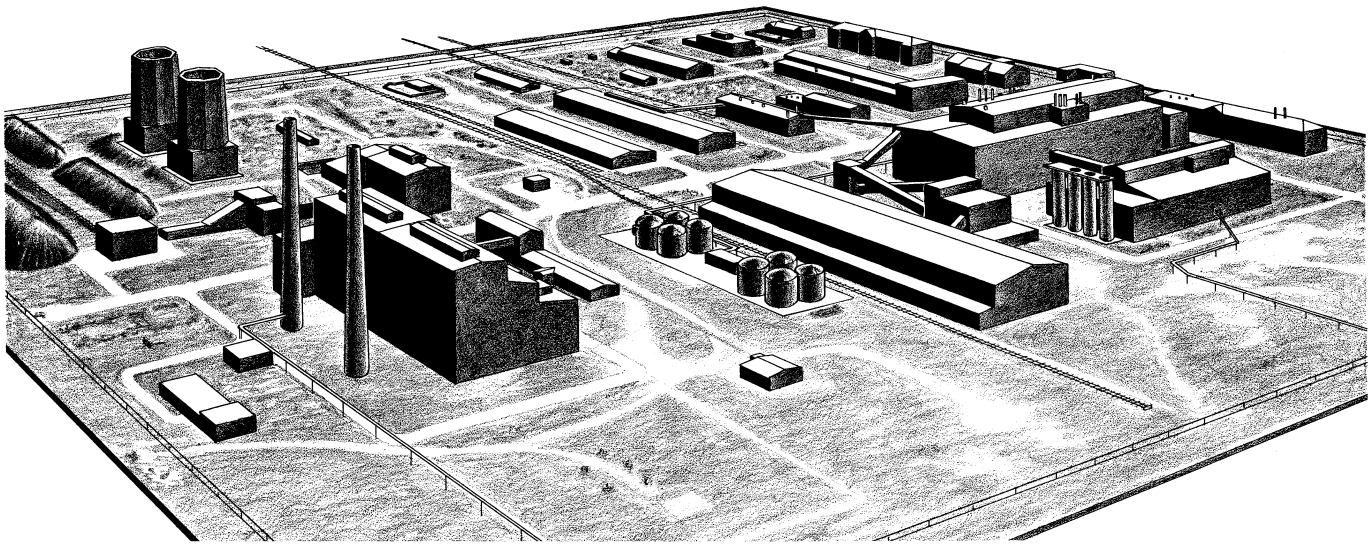

FIG. 7 PERSPECTIVE VIEW OF PYATIGORSK URANIUM PROCESSING PLANT This view shows the thermal electric power plant at the left and the uranium concentration plant at the right

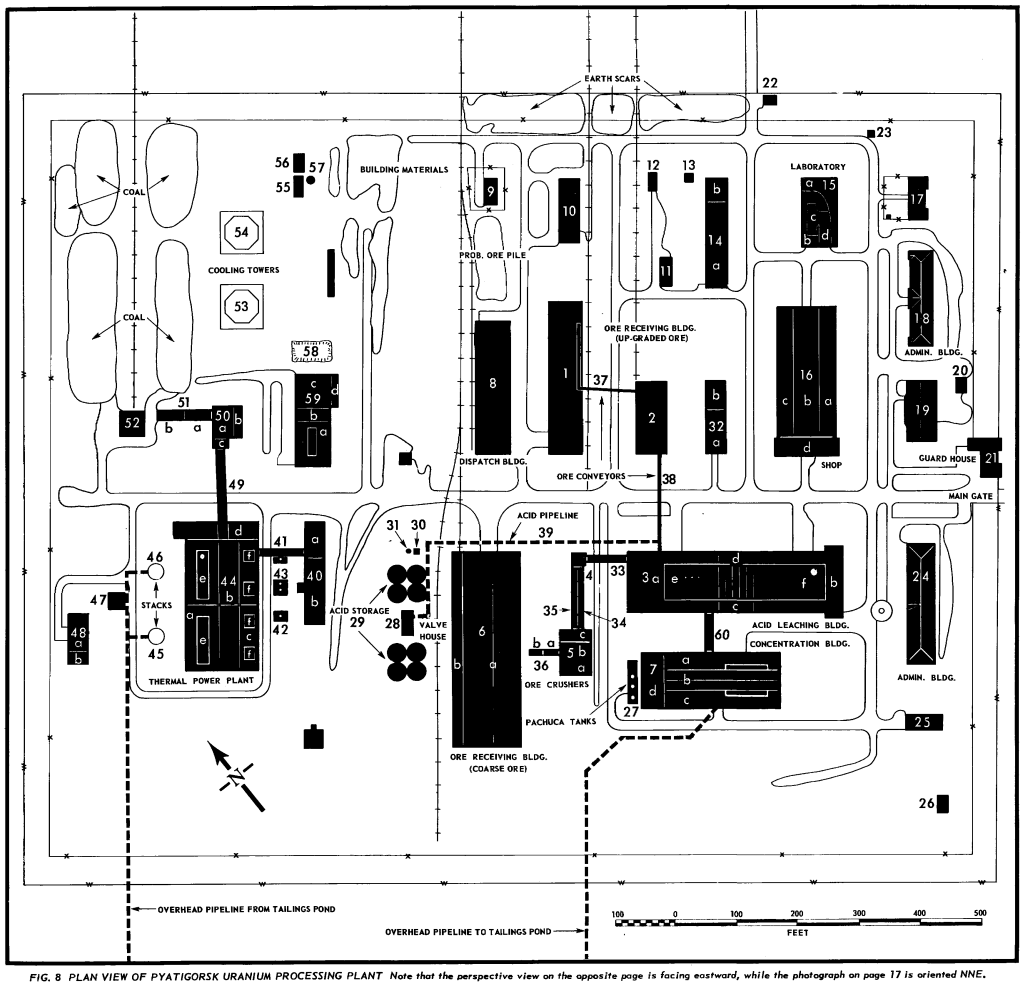

FIG. 8 PLAN VIEW OF PYATIGORSK URANIUM PROCESSING PLANT Note that the perspective view on the opposite page is facing eastward, while the photograph on page 17 is oriented NNE.

25X1

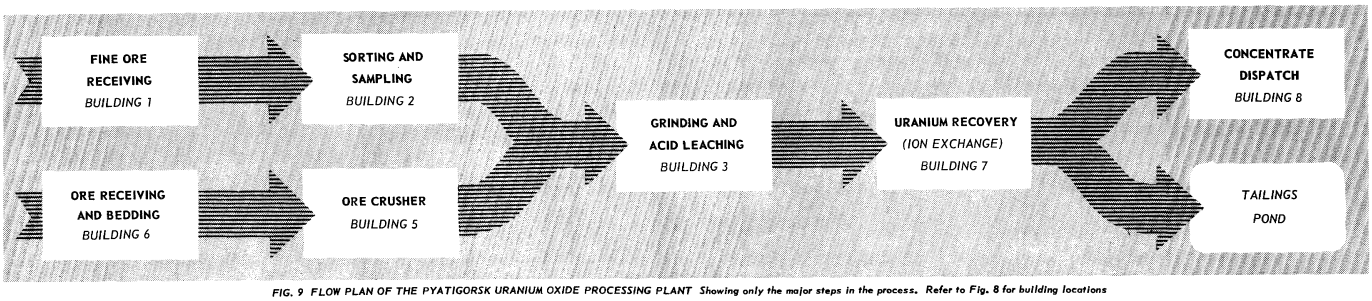

FIG. 9 FLOW PLAN OF THE PYATIGORSK URANIUM OXIDE PROCESSING PLANT *Showing only the major steps in the process. Refer to Fig. 8 for building locations*

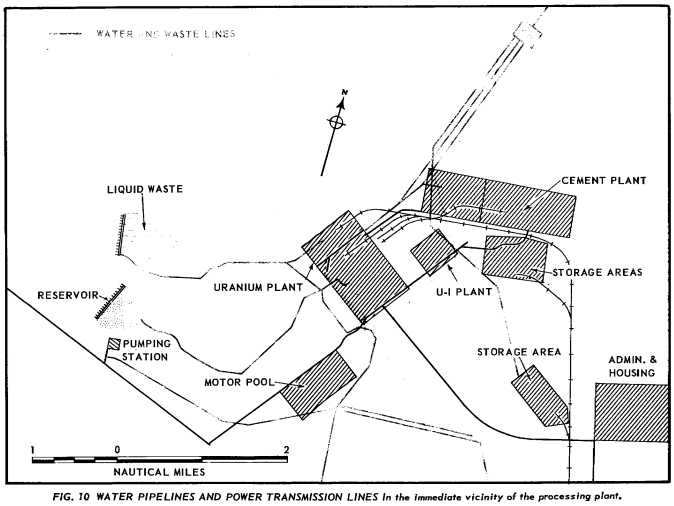

FIG. 10 WATER PIPELINES AND POWER TRANSMISSION LINES *In the immediate vicinity of the processing plant.*

at the northwest end of Building 7 could be used for neutralizing the solutions and tailings or for manganese recovery. 20/*

Uranium Oxide Recovery: The final stage in the recovery of uranium oxide from the ore occurs in Building 7, which is almost identical in size and configuration to an ion-exchange building designed by Porter for construction in South Africa.

The possible reagent combination used in the plant would be sulphuric acid for leaching, lime for neutralization of the solutions and tailings, and either salt, or sulphuric or nitric acid, for stripping of the ion-exchange resins. 21/*

Production Estimate: The estimate of production of uranium oxide is based on 1) the grade of ore entering the plant and 2) the size of the tailings pond.

The grade of the ore entering the plant is difficult to estimate, but from the amount of selective mining that is taking place in the mining areas it could be estimated that the grade would be similar to other Soviet uranium enterprises, where the grade is believed to be in the neighborhood of .2 to .3 percent uranium oxide. Since it has been estimated that the upgraded crushed ore might also be of that grade, it is felt that this may be the average of the feed to the plant. 22/

It appears that there are between 800,000 and 1,000,000 tons of tailings in the tailings pond, which would mean that during the 2.5- to 3-year period about 400,000 tons of ore a year or 1000 metric tons a day had been processed. Estimating the grade at .2 percent uranium oxide, or four pounds in a ton of ore, the yield would be 3500-4000 pounds of uranium a day. This rate of production agrees with the known production of the South African mill after which the Pyatigorsk mill was probably modelled. Recovery should be extremely high, probably 90 to 92 percent, so that it appears safe to estimate that the production would be close to 4,000 pounds of uranium oxide a day, or approximately 700 metric tons a year. The product from this plant would be a very high concentrate ranging from 85 to 90 percent uranium oxide. 23/

Dispatching: The concentrate is sent from Building 7 to Building 8 for packaging and shipping. Packaged concentrates may leave the dispatch building by rail or truck. Shipments have been reported by truck, 24/ but this method of shipment is probably used only to by-pass heavy ore-car traffic between the mill and the main rail line at Mineral'nyye Vody. At other times shipments would be entirely by rail.

Waste: Liquid waste is deposited in two probable semi-buried uranium recovery tanks 4100 feet NNE of the plant and in a tailings pond 2900 feet west of the plant. pipelines carry liquid waste to the tanks for probable settling out of concentrates lost in the leaching process. Other pipes convey the recovered material back to the plant. Water reclaimed after the residue settles out is probably used by the power plant. Remaining waste is carried by an-

* Porter incorporated pachuca tanks for manganese recovery in the plant he designed.

* Manganese oxide may also be used as a reagent at the Pyatigorsk plant. It is readily available from mines in the igneous intrusions.

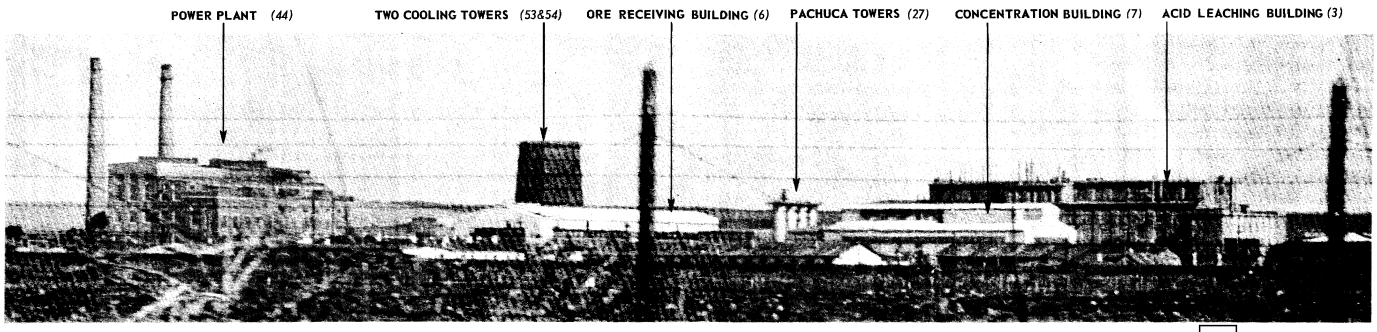

FIG. 11 GROUND PHOTOGRAPH OF PROCESSING PLANT Photograph taken from highway southwest of plant on 30 Nov. 1956. Numbers refer to building locations in Fig. 8. Note presence of only one cooling tower i[redacted]

25X1

other pipe to an escarpment 1100 feet farther NNE. Material separated in neutral filtration is piped from the plant to the tailings pond. An earth dam approximately 30 feet high retains the solid waste material. The pipeline from the processing plant runs along the top of the south wall of the pond and turns north along the length of the crest of the dam. The tailings here are indicative of 2.5 to 3 years of operation.

PLANT SUPPORT FACILITIES

The buildings in the northeast quadrant of the plant area have administrative and maintenance functions. Building 32 and buildings 11-14 are probably supply and commissary buildings. Building 15 has elaborate ductwork on the roof, suggesting its use as a laboratory. Building 16 is a shop-type building, probably the center of millwright activities. Building 17 is probably the plant superintendent's quarters, and Buildings 18 and 19 are probably dormitories for mill workers and for the plant security force. Building 24 is either an administrative building or a laboratory.

Power Supply: Within the uranium mill there is a large coal-fired thermal power plant with an estimated capacity of 10-16 megawatts. In addition to supplying the uranium plant, it provides power for much of the entire complex. Lines run from the generator hall to a large transformer yard which lies outside the south corner of the processing plant. From the transformer yard, transmission lines branch out to the mines, the housing areas, and to the other supporting facilities.

Water Supply: A lake created by an earth dam adjacent to the tailings pond is a partial source of water supply for the processing plant. It probably contains a minimum of 18 million gallons of water. This reservoir did not exist in 1956. 25/ Another man-made lake at the base of Gora Sheludivaya holds about 14 million gallons of water. In addition, there are two semi-buried probable water storage reservoirs each about 65 feet in diameter adjacent to the crushing mill on the west slope of Gora Beshtau. On the east side of Gora Byk is a small water treatment plant, connected with the Gora Byk crushing plant, which may be for water purification or for sewage treatment.

Storage: Within the plant area there are eight cylindrical tanks approximately [redacted] located between the processing buildings and the power plant. These tanks are used for the storage of acids, and are computed to have a total capacity of about 6.5 million gallons.

Several fenced storage facilities lie on the south side of the rail yard adjacent to the shop area. One of these is rail-served with a spur passing through a building into what appears to be a metal storage yard, which is served by a gantry crane. A row of warehouse-type buildings lies adjacent to the probable metal storage yard, and to the east there is a small storage area containing eight buildings of various sizes.

Another storage facility, to the west of the mining district headquarters, is both road and rail-served and is secured by a wall. Within this compound there are four major buildings, eight smaller buildings, and a considerable amount of unidentifiable open storage.

Transportation: The Pyatigorsk mining and milling complex is served by a broad-gauge rail line that terminates at the processing plant. A five-track rail yard northeast of the plant provides car storage. At the time of photography there were at least 38 freight cars in the plant area. A spur line leads from the processing plant to the mine and crushing mill three miles to the east. Roads connect the processing area with Pyatigorsk and with all sections of the mining area. There is a large motor pool near the processing plant.

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Subsidiary Plants: There is a large construction materials plant adjacent to the processing plant. It includes a sawmill and a lumber yard, as well as a cement plant. These facilities are all served by rail.

A new, unidentified plant lies between the processing plant and the rail yard. The main building is a large structure with a monitor roof.

Housing: The main workers' housing area is about one nm SE of the processing plant. Included in the area is a large group of apartments which were still under construction at the time of photography, and about 235 individual homes, of which about 75 were still under construction. These units will accommodate 6000-9000 people using a factor of 600-800 square feet for each family. In addition, some old tempo-

rary housing nearby could shelter about 2200 workers, and an adjacent forced labor camp could accommodate about 700.

A "VIP" or laboratory area on the west slope of Gora Beshtau will probably house about 90-100 people. The area is isolated, but is served by a good road. The area is well laid out, with four apartment buildings that appear to be permanent structures, and eight other buildings that may house laboratories. On the southeast slope of Gora Beshtau there is a workers' camp that has eight barrack-type buildings with a total floor space of about 11,000 square feet, capable of housing up to 185 workers, and about 43 individual dwellings.

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